ELEC 462/562: Optoelectronic Devices

10:50 – 12:05, Tuesday & Thursday, Fall 2019
Brockman Hall, Room 103
Department of Electrical and Computer Engineering, Rice University

Instructors: Prof. Junichiro Kono, Brockman Hall, Room 351, Phone: x2209

Grader:
Jorge Zepeda

Course Description:
This course provides an introduction to the fundamental principles of semiconductor optoelectronic devices. After reviewing the basic elements of quantum mechanics of electrons and photons, light-matter interaction (including laser oscillations), and semiconductor physics (band structure, heterostructures and alloys, optical processes), we will study the details of modern semiconductor devices for generating, detecting, and modulating light.

Required Text:
E. Rosencher & B. Vinter, *Optoelectronics (Cambridge)*

Recommended References:
S. L. Chuang, *Physics of Photonic Devices (Wiley)*
S. O. Kasap, *Optoelectronics and Photonics: Principles and Practices (Pearson)*
A. Yariv, *Quantum Electronics (Wiley)*
A. E. Siegman, *Lasers (University Science Books)*
R. W. Boyd, *Nonlinear Optics (Academic Press)*
C. Weisbuch & B. Vinter, *Quantum Semiconductor Structures: Fundamentals and Applications (Academic Press)*
J. H. Davies, *The Physics of Low-Dimensional Semiconductors: Introduction (Cambridge)*
J. Singh, *Physics of Semiconductors and Their Heterostructures (McGraw Hill)*
G. Bastard, *Wave Mechanics Applied to Semiconductor Heterostructures (Wiley/Halsted Press)*

Homework:
A problem set will be assigned every other week.

Grading:
Homework 40%; Midterm Exam 30%; Final Exam 30%.

Syllabus:

1. **Basic Elements of Quantum Mechanics and Light-Matter Interaction**
   - **1.1. Time-independent Schrödinger equation**
   - **1.2. Perturbation theory and transition probabilities**
   - **1.3. Linear optical susceptibility**
   - **1.4. Absorption, stimulated emission, and spontaneous emission**
   - **1.5. Laser oscillations**

2. **Basics of Semiconductor Physics**
   - **2.1. Band structure**
   - **2.2. Electronic and optical properties of semiconductors**
   - **2.3. Semiconductor heterostructures and quantum wells**

3. **Optoelectronic Devices**
   - **3.1. Waveguides**
   - **3.2. Photodetectors and solar cells**
   - **3.3. Light emitting diodes**
   - **3.4. Laser diodes**

Disability-Related Accommodations:

Any student with a documented disability needing academic adjustments or accommodations is requested to speak with me during the first two weeks of class. All discussions will remain confidential. Students with disabilities should also contact Disability Support Services in the Ley Student Center.